# Does Portfolio Theory Work During Financial Crises?

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It is sometimes said that portfolio theory fails during financial crises because:

−All asset classes go down;

−All correlations go up.

These statements are true, roughly, but should be preceded by the phrase "As predicted by portfolio theory" and followed by the phrase, "which is why one should use MPT, Modern Portfolio Theory."

The above statement is most easily explained if we do not go back to the general formulation of MPT in Markowitz (1952) and (1959), but use William Sharpe's (1963) "Simplified Model of Portfolio Theory." The former considers how to diversify given any pattern of correlations among risks; the latter assumes a "one-factor model." Specifically, Sharpe's "simplified model" assumes that each security is correlated with each other security because all are correlated with "the market." The return on a security is equal to

*A constant called the security's "alpha"*

*plus*

*Another constant, the security's "beta"*

*times*

*A random underlying factor sometimes called the return on the market*

*plus*

*An independent, random so-called "idiosyncratic" term.*

The last two terms--the common underlying factor and the uncorrelated idiosyncratic

term--are the two sources of period-to-period (e.g., day-to-day, month-to-month or year-

to-year) fluctuations.

Sharpe's one-factor model assumes that the idiosyncratic random term of one

security is uncorrelated with that of any other security and with the underlying factor.

Thus, in this simplified model one security is correlated with another only because both

are correlated with "the market."

It follows from Sharpe's assumptions about security returns that the return on the

***portfolio-as-a-whole*** also equals

The *portfolio's* alpha

plus

The *portfolio's* beta

times

The underlying factor;

plus

The *portfolio's* idiosyncratic term

In particular:

-the portfolio's idiosyncratic term is uncorrelated with the underlying factor;

-the alpha of the portfolio is a weighted average of the alphas of the individual
stocks, weighted by portfolio holdings;

-the beta of the portfolio is similarly a weighted average of the betas of the
individual stocks, again with weights equal to portfolio holdings;

-during any interval of time (day, month, year) the idiosyncratic term of the
portfolio during this period is the weighted average of the idiosyncratic terms of
the individual securities;

-however, the variance of the idiosyncratic term is not the weighted sum of the securities' idiosyncratic variances:  It is *less* than that!

Since the securities' idiosyncratic terms are uncorrelated, they tend to diversify: With a high probability some will do well when others do poorly.

With a sufficiently large, well-diversified portfolio the variance of the portfolio's idiosyncratic term is negligible. This is not true of the variance due to what is called the *systematic risk,* that is, the risk due to the beta of the portfolio times the possible up or down movement of "the market."  "Systematic risk", due to beta, does not diversify away; unsystematic risk does.

For example, suppose that all securities in a portfolio have the same alpha: then the portfolio will have that alpha.  Also suppose that each security has the same beta: then the portfolio will have the same beta as each of its securities.  But if the variances of the idiosyncratic terms of the securities are the same, the variance of the idiosyncratic term for the portfolio will *not* be the same: It will be *smaller* than that of each of its securities. The idiosyncratic risks diversify away.  The systematic risk (due to beta times the market) does *not* diversify away.

**Crises**

In terms of Sharpe's model, a crisis by definition is a period of time during which there is a large downward movement of the underlying factor--perceived as a large movement in the market.  This period of time may be a day when the market drops dramatically, as during October 19, 1987, or an extended period like October 1929 through 1932.

Even assuming that the alphas, betas, and variances of the idiosyncratic terms of the individual securities remain constant throughout the crisis, almost all securities and asset classes will move in the same direction. This does not mean that individual securities are no longer subject to idiosyncratic risks. Rather it means that the systematic risk swamps the unsystematic risk during this period. Nor does it mean that all securities or asset classes have fallen equally during the period. A high beta security will probably have a very large move, unless it is lucky with its idiosyncratic term; a low beta security will probably have a small downward move unless it is unlucky with its idiosyncratic term. (Few, if any, securities have negative betas.)

The Year 2008 is a good example. The S&P 500 fell approximately 36.8% whereas a higher-beta emerging-markets asset class index fell by 53.9%. Corporate bonds fell in value, but much less than equities, and government bonds went up. In particular, a 5-Year Government Fixed Income Index rose by 8.4%. Small stocks went down, but not as much as you would have expected given their historically higher volatility as measured by standard deviation of returns; a small-cap index fell by 36.0%, but carries a 80-year standard deviation of returns of 24.8%. In contrast, a usually less volatile large-cap index (comparable to the S&P 500 Index) carries an 80-year standard deviation of returns of 19.2%. On the average they had lucky idiosyncratic terms during that interval of time. Generally, asset classes moved roughly in proportion to their historical betas.

**Appropriate Implementation of MPT**

As is the accepted practice for applying MPT on behalf of investors, financial advisors should perform a risk-return analysis at the asset class level. Implementation of such requires forward-looking estimates of the likely returns and risks of, and correlations among, various asset classes, and uses these as the inputs to an MPT (mean-variance) analysis. This produces a curve of "efficient" risk-return combinations. A given efficient risk-return combination gives maximum average return for its level of risk. If you want greater return on average, you have to take on greater risk; if you want less month-to-month and year-to-year fluctuations, you have to accept less return on the average in the long run.

These ideas are illustrated by Figures 1 through 3. For example, Figure 1 shows that the large capitalization value stocks did less well on average, from January 1928 through December 2008, than small-cap value stocks; but the former was subject to less volatility than the latter. (The greater volatility of the small-cap stocks is more apparent in the early days, e.g., 1929 to 1932, than it is later when the two curves have separated.)

The orange line of the logarithmic growth-of-a-dollar chart depicts a combination of simulated and live return data for a five year global fixed income index.
It had the least growth on average but was the most stable. For completeness, the chart also includes growth-of-a-dollar data for a U.S. small growth index as well as a U.S. large growth index. As you can see, these indices have carried less growth and substantial volatility. For this reason, we find that it is not advisable to invest funds in these particular asset classes.
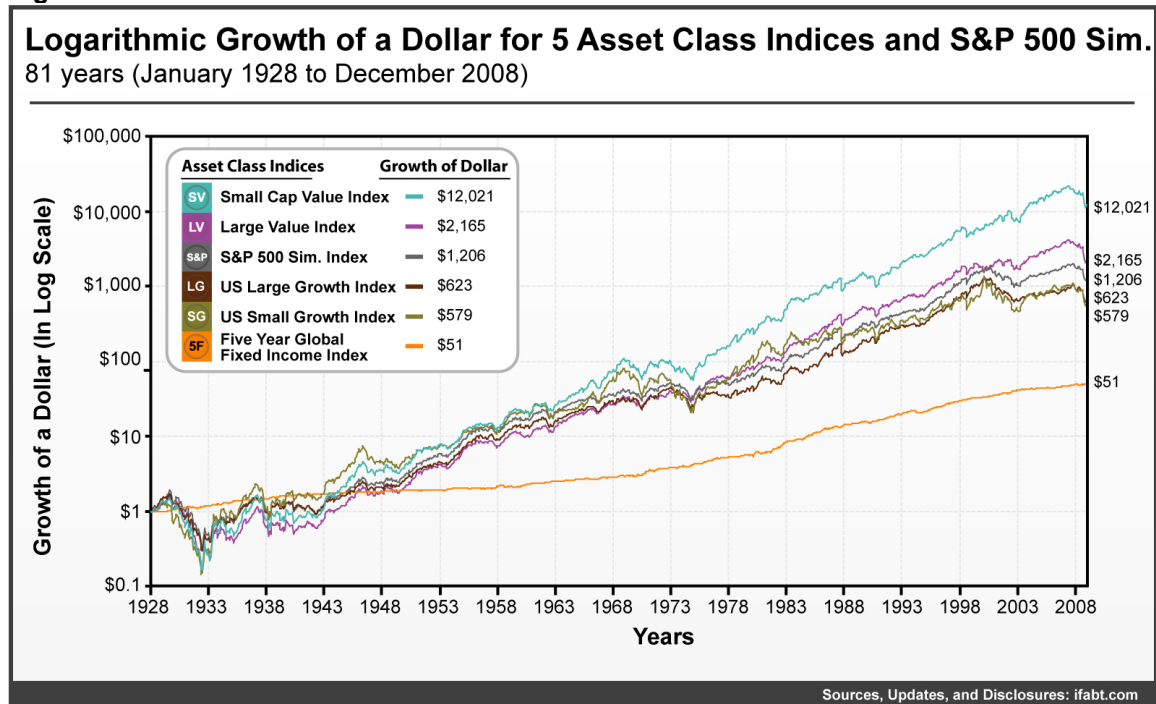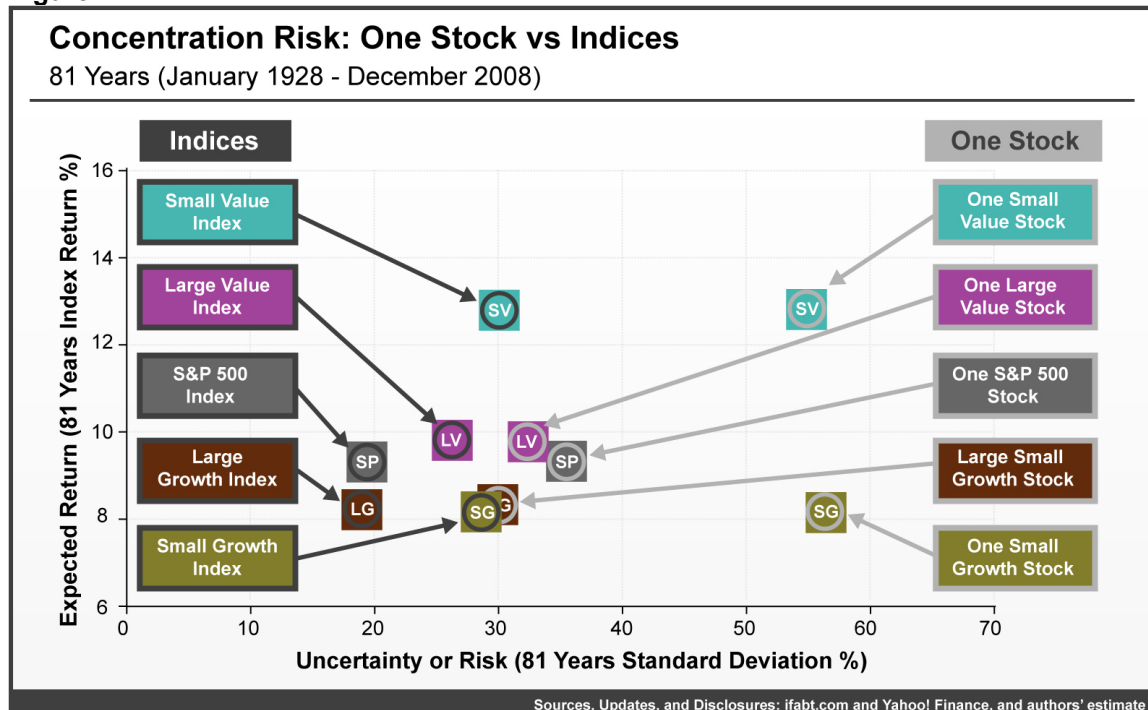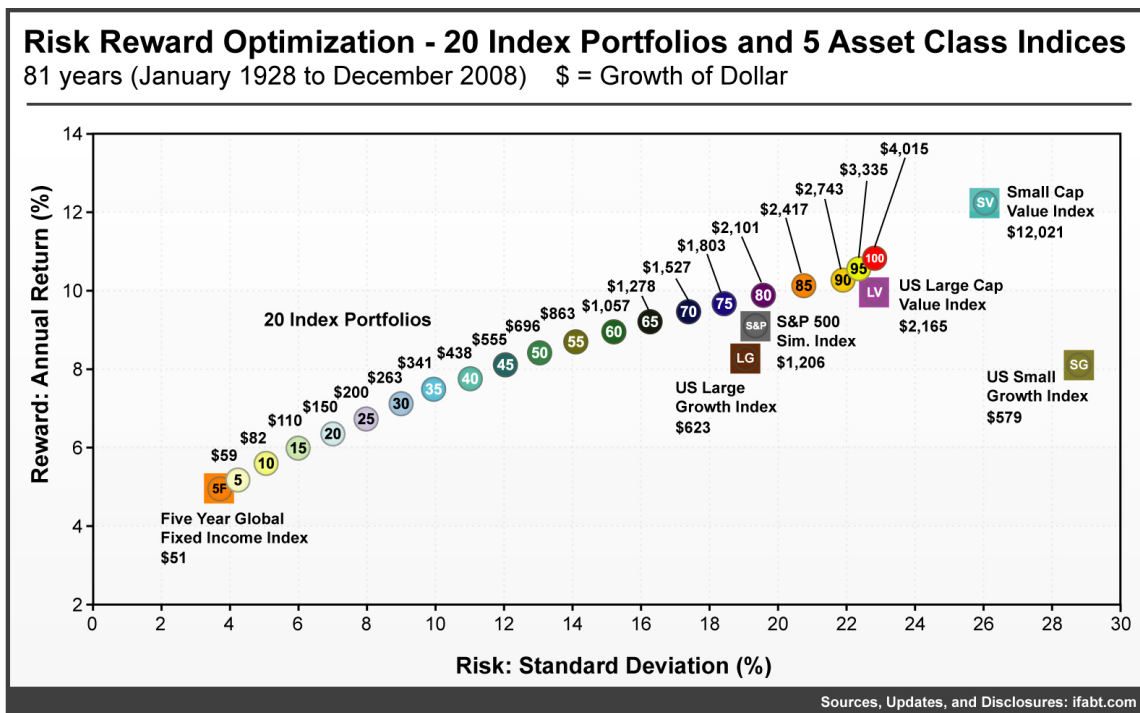
**Figure 1**



**Logarithmic Growth of a Dollar for 5 Asset Class Indices and S&P 500 Sim.**
81 years (January 1928 to December 2008)

Figure 2 summarizes the information in Figure 1.  The horizontal, "X", axis shows volatility or riskiness, as measured by the statistician's "standard deviation."  The vertical, "Y", axis presents average annual return. The historic risk and returns of a typical individual security in each asset class are on the right side.  On the left are the historic risk-return combinations of indices of these securities. Clearly, diversifying within an asset class reduces risk as compared to investing in one (or a few) securities in the asset class for the same level of expected return.

**Figure 2**



**Concentration Risk: One Stock vs Indices**
81 Years (January 1928 - December 2008)

Indices | One Stock

Small Value Index | One Small Value Stock
Large Value Index | One Large Value Stock
S&P 500 Index | One S&P 500 Stock
Large Growth Index | Large Small Growth Stock
Small Growth Index | One Small Growth Stock

Expected Return (81 Years Index Return %)

Uncertainty or Risk (81 Years Standard Deviation %)

Sources, Updates, and Disclosures: ifabt.com and Yahoo! Finance, and authors' estimate

But it is better still to diversify across asset classes as well as within asset classes, as shown in Figure 3. The index portfolios labeled 5 through 100 represent a continuum of historic risk and return performance of various index portfolios with varying combinations of stocks and bonds. Specifically, they are mixtures of diversified stock indices and diversified bond indices. The portfolio labeled 5 is 15 percent stocks and 85% bonds. The index portfolio labeled 90 is 100% percent stock fund, and represents the stock portion of each portfolio between these. (The portfolios labeled 95 and 100 employ a more aggressive stock tilt toward small and value indices than the all-equity index portfolio 90.) The squares represent individual indices and illustrate how small value has a higher return and lower risk than small growth and large value has a higher return and higher risk than large growth.

**Figure 3**

**Risk Reward Optimization - 20 Index Portfolios and 5 Asset Class Indices**
81 years (January 1928 to December 2008)   $ = Growth of Dollar

Diversifying between asset class portfolios as well as within portfolios is more "efficient" than doing only one of these, or neither.

Investing in a diversified portfolio is of fundamental importance, but which level of risk exposure is appropriate for each investor? The identification of an investor's proper risk exposure depends on five dimensions of an investor's risk capacity. These five dimensions include: time horizon and liquidity needs, net income, net worth, investing knowledge and attitude toward risk. ("Investor" here may refer to an individual, family or institution). Finally, the investor should be educated as to what risk exposure of investment funds provides the portfolio with the risk-return combination that is in keeping with their risk capacity.

In so far as Sharpe's one-factor model is correct, the higher risk--and higher return--portfolios tend to have higher beta stocks; the less risky portfolios tend to have lower beta stocks. The former will tend to do better on average over the long run, but

usually decline more during crises when systematic risks swamps diversifiable idiosyncratic risk. The opposite statements apply for portfolios of lower risk.

**The Many-Factor Model**

Sharpe's one-factor model assumes that the idiosyncratic terms of each security are uncorrelated with that of each other. Experience has shown that the idiosyncratic terms of various pairs of securities are themselves correlated, reflecting the existence of additional factors. Soon after the publication of Sharpe's one-factor model, King (1966) presented convincing evidence for the existence of industry factors. Rosenberg (1974) presented a model, which became widely used, that included "fundamental factors" as well as industry factors. A simpler, now widely used model is the Fama and French (1995) three-factor model that adds a large versus small cap factor, and a value versus growth factor to the general market factor. This is the reason for the small cap versus large cap and the growth versus value indices, combinations of these (such as small cap value) and investment funds that track these indices.

At times other factors, usually negligible, push their way to the front. For example, sometimes no great premium is placed on liquidity: illiquid assets are found attractive if they have moderately higher expected returns. At other times liquidity is deemed priceless.

A memorable example of a factor pushing itself to the fore was the fall of Long Term Capital Management. LTCM systematically went short liquid assets, such as 30-year Treasuries, and long closely related illiquid securities, in this case the 29-year-until-maturity Treasuries. In addition, they leveraged heavily. When Russia defaulted the

market placed a great premium on liquidity. LTCM's leveraged bet on illiquid over liquid securities brought them down when this particular attribute of securities pushed itself to the front as a risk factor. Thus, in general, it is dangerous to have a portfolio concentrated on any one aspect of securities.

If the one-factor model were true one could control a portfolio's risk by controlling the portfolio's beta and dividing funds among any large number of securities. When industry and other non-market factors are taken into account, it is clear that one is not well diversified if one has many securities, but is concentrated in a few industries, or heavily exposed to some fundamental factor like growth as opposed to value or small cap as opposed to large cap stocks.

When one measures correlations (e.g. from weekly or monthly data) during fierce bear markets they tend to be higher than in more benign bull markets. It is generally observed that markets fall faster during bear markets than they rise during bull markets, except possibly during the last manic phase of the bull run. They also tend to have wilder swings—both up and down--during a bear market. For example, in the first quarter of 2009, correlations were higher than their historical averages, with the exception of the pairing of EAFE and Emerging Markets.

As we noted above, at such times large moves in the market-as-a-whole—i.e., systematic risk--tends to swamp idiosyncratic risk as evidenced by increased correlations.

**Diversification versus Concentration**

If diversification is of little use during crises, then concentrated portfolios should do perfectly well. Consider the performance of concentrated portfolios during 2008. Their performance clearly depends on what they were concentrated in. If a portfolio was concentrated in government bonds, it would have done quite well. (The problem with investing all one's wealth in government bonds, of course, is that they usually yield less than corporate bonds and, over the long run, their performance is much less than that of equities.) On the other hand, if a portfolio had been concentrated in AIG, Citigroup, General Motors, or the financial or auto industries generally during 2008, the result would have been tragic.

**Conclusion**

At any point in time we look back at the past, and make our estimates and decisions for the future. The future is always uncertain. At any time we should make our best estimates for "the next spin of the wheel," and then choose an appropriate point from the implied risk-return trade-off curve. Depending on our risk capacity, perhaps we will select a more cautious portfolio, loaded with lower beta securities or asset classes; or conversely, we will choose a point higher on the frontier, with higher yield but with higher beta securities or asset classes. If the market goes up dramatically, those with high beta portfolios will be happy; if it goes down they will be sad. "You pays your money and you takes your choice!"

For any choice of portfolio, MPT will follow the old (but still true) adage, "Don't put all your eggs in on basket."

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